REMARKS

Claims 1 and 3-11 are pending, with claim 1 being in independent form. By the present amendment, claim 8 is amended to depend from claim 1, and claims 2 and 12-15 have been canceled without prejudice or disclaimer.

At the outset, the Applicant acknowledges with appreciation the Examiner's favorable consideration of the prior-filed Amendment and Declaration and the subsequent withdrawal of the rejections raised in the prior Action.

In this Office Action, claims 1-9 and 11-15 stand rejected for an alleged lack of enablement. In particular, the Office asserts that the

> disclosure fails to teach the ordinary skill worker in the art the myriad possibilities which would fulfill the thickness in the range where the ratio of perpendicular coercivity-to-maximum perpendicular coercivity decreases with reduced thickness of the perpendicular magnetic recording layer as claimed and that the soft magnetic layer and the perpendicular magnetic layer form closed magnetic loops as claimed without undue experimentation in the unpredictable recording disk art.

Applicant respectfully disagrees for the following reasons.

With respect to the feature of "the perpendicular magnetic recording layer having a thickness in the range where the ratio of perpendicular coercivity *Hc* to maximum perpendicular coercivity *Ho* decreases with reduced thickness of the perpendicular magnetic recording layer", persons skilled in the art understand that the perpendicular coercivity *Hc* of a film of magnetic material changes as the thickness of the film is varied. It is also well known that the magnetic coercivity of a film increases with the thickness of the film, reaches a maximum *Ho*, and then can decrease as the film thickness is increased further. In addition, it is well understood that different magnetic materials exhibit different maximum perpendicular coercivities. Finally, it is well within the level of ordinary skill in this art to determine the coercivity of a magnetic material. Indeed, U.S. Patent No. 6,641,934 to Suzuki et al. ("Suzuki"), cited by the Examiner in the Action, describes a technique for determining the coercivity of a material at col. 7, ll. 6-11.

With the above as background, Applicant contends that no undue experimentation is required to follow the teachings of the originally-filed application in order to form a perpendicular magnetic recording (PMR) layer having a thickness in the range where the ratio of perpendicular coercivity *Hc* to maximum perp ndicular coercivity *Ho* decr ases with reduced thickness of the PMR layer. Once a material

is selected in accordance with the present invention, the skilled artisan need only measure or access data (if available) about the perpendicular coercivity *Hc* of the material for varying thicknesses of the material to determine the maximum coercivity *Ho* of the material. The result will be a plot similar to the ratio of *Hc/Ho* for CoCr shown in FIGS. 4 and 6.

Once generated, the artisan can use the plot of the ratio of *Hc/Ho* to readily determine thicknesses for the material in the range where the ratio of perpendicular coercivity *Hc* to maximum perpendicular coercivity *Ho* decreases with reduced thickness of the PMR layer. For example, for the CoCr material shown in FIGS. 4 and 6, it can easily be determined that the computed ratio decreases with reducing thicknesses of about 50nm and lower. The plot of the ratio of *Hc/Ho* need only be generated once for a given magnetic material, and can be used thereafter to determine the range of thicknesses defined in claim 1.

The test of enablement is not whether any experimentation is necessary, but whether, if experimentation is necessary, it is undue. *In re Angstadt*, 537 F.2d 498, 504, 190 USPQ 214, 219 (CCPA 1976). With respect to determining the thickness of the PMR layer, Applicant respectfully asserts that the "experimentation" required to determine the thickness, if any, is not undue and is in fact very routine. Further, Applicant respectfully submits that the specification, together with knowledge commonly known in the art, fully enables the skilled artisan to practice the invention defined by claim 1. Accordingly, the Examiner is requested to reconsider and withdraw the enablement rejection for at least this reason.

With respect to the feature of "an intermediate soft magnetic layer between the underlayer and the perpendicular magnetic recording layer for forming closed magnetic loops together with the perpendicular magnetic recording layer", Applicant again contends that no undue experimentation is required by the skilled artisan to arrange the soft magnetic layer so as to form a closed magnetic loops together with the PMR layer. Persons skilled in the art will understand that a closed magnetic loop (or circuit) includes arrangements where the flux path external to a permanent magnet for instance is confined within high permeability materials for instance that compose the magnetic circuit. In contrast, an open magnetic circuit includes arrangements where the flux path xternal to the permanent magnet travels partially or compl tely though a non-magnetic material (usually, but not necessarily air).

Thus, to arrange the soft magnetic layer so as to form a closed magnetic loop together with the PMR layer, a person need only determine the magnetic flux line pattern associated with a particular magnetic head type of choice (e.g., a ring-type head) at a particular magnetomotive force, and then arrange the soft magnetic layer, accordingly. Indeed, the magnetic flux line patterns associated with certain magnetic head designs may be available without having to characterize a particular head design, but having to first characterize a particular magnetic head design do so cannot be said to require undue experimentation.

Applicant describes on page 3 of the application, in conjunction with the embodiment shown in FIG. 2, that having an intermediate soft magnetic layer 26 deposited between a perpendicular orientation promoting underlayer 22 and a PMR layer 23 allows formation of a closed magnetic circuit through the PMR layer 23 by perpendicular magnetic field components, such as those from a ring-type head. The closed magnetic circuit formed by the intermediate soft magnetic layer 26 reduces the demagnetization factor of the PMR layer 23 and its demagnetization energy, and thereby limits reduction in the effective perpendicular magnetic anisotropy energy.

The skills required to arrange the soft magnetic layer so as to form a closed magnetic loop together with the PMR layer is within the knowledge of the skilled artisan, and thus need not be described in detail in the specification to satisfy the enablement requirement. A patent need not teach, and preferably omits, what is well known in the art. *In re Buchner*, 929 F.2d 660, 661, 18 USPQ2d 1331, 1332 (Fed. Cir. 1991). Accordingly, Applicant respectfully requests that the Examiner reconsider and withdraw the enablement rejection for these reasons as well.

It will be understood from the above statements that while the Applicant contends that the written description, coupled with information known in the art, fully enables the skilled artisan to determine an appropriate thicknesses of the soft magnetic and information recording layers to practice the invention, these statements should not be interpreted as acknowledging or even suggesting that arrangements having such layers with the claimed determined thicknesses was known or obvious to those skilled in the art at the time of the invention.

Turning to the art rejections, claims 1-7 and 11-15 stand rejected as being either anticipated or obvious in view Suzuki. The Office indicates that Suzuki qualifies as either Section 102(a) or 102(b) art, but upon review it is believed that the

Office meant to invoke 35 U.S.C. §102(e). Notwithstanding this, the pending claims are considered allowable over Suzuki for the following reasons.

Anticipation requires that every feature of the claimed invention be shown in a single prior document. *In re Paulsen*, 30 F.3d 1475 (Fed. Cir. 1994); *In re Robertson*, 169 F.3d 743 (Fed. Cir. 1999). The pending claims positively recite features that are not described in the cited document.

For example, claim 1 recites, among other things, "the perpendicular magnetic recording layer having a thickness in the range where the ratio of perpendicular coercivity *Hc* to maximum perpendicular coercivity *Ho* decreases with reduced thickness of the perpendicular magnetic recording layer". The Office admits that Suzuki does not explicitly describe this feature, but contends that the feature is "an unidentified property" that is inherent in the cited document. Applicant respectfully disagrees.

The initial burden of proof in showing inherency lies with the Patent Office. To establish inherency, the extrinsic evidence "must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient." *In re Robertson*, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999).

In support of the assertion of inherency, the Office states that " Suzuki appears to encompass [the recited feature], since they disclose the same structure materials and thickness as applicant" (emphasis added). As stated above, the mere appearance of the presence of an inherent feature is not sufficient to carry the Patent Office's burden of proof. Moreover, the assertion that Suzuki describes the same structure, materials, and thickness as Applicant is incorrect.

For example, Suzuki describes a structure that differs significantly from that described and claimed by Applicant. Suzuki's structure includes a layer of non-magnetic material 20, 21 disposed between the soft magnetic layer 30, 31 and the information recording layer 10, 11. In contrast, the structure defined by claim 1 includes "an intermediate soft magnetic layer between the underlayer and the perpendicular magnetic recording lay r for forming closed magnetic loops together with the perpendicular magnetic recording layer". Accordingly, the claimed closed-

field structure defined by claim 1 does not include a non-magnetic material as described by Suzuki.

Second, the information recording layer material described by Suzuki is not the same as those described and claimed by Applicant, as the Office contends. For example, Applicant describes that the PMR material can comprise a CoCr alloy (e.g., in claim 7 and throughout the specification). In contrast, Suzuki explicitly discourages the use of a CoCr alloy at col. 1, ll. 48-49, advocating instead the use of an information recording layer 10 made of a thin film of ordered alloy with $L1_0$ crystal. Col. 1, l. 66 - col. 2, l. 1.

Finally, Suzuki does not describe the same thickness as that which is described and claimed in this application, as the Office contends. Instead, Suzuki describes a broad range that at best overlaps the thickness described and claimed in this application. For example, Suzuki describes at col. 4, ll. 22-27 that "the film thickness of the information recording layer 10 of ordered alloy with $L1_0$ crystal structure may be determined from the viewpoint of recording and reproducing characteristics, and the thickness is not particularly specified, but it may be designed in a range of about 5 to 200 nm" (emphasis added). In contrast, FIGS. 4 and 6 of this application show that for a PMR layer comprising CoCr, the ratio of perpendicular coercivity *Hc* to maximum perpendicular coercivity *Ho* decreases with reducing thicknesses of about 50nm and lower.

According to the MPEP, when a prior document discloses a range which touches, overlaps or is within the claimed range, the claimed subject matter must be disclosed in the prior document with "sufficient specificity to constitute an anticipation under the statute". If the claims are directed to a narrow range, the prior document teaches a broad range, and there is evidence of unexpected results within the claimed narrow range, depending on the other facts of the case, it may be reasonable to conclude that the narrow range is not disclosed with "sufficient specificity" to constitute an anticipation of the claims. The unexpected results may also render the claims unobvious. See "Anticipation of Ranges", MPEP § 2131.03.

As in the example provided in the MPEP, the claims of this application can be said to be define a narrower range than the broad range disclosed in the prior document. In addition, there is evidence here of unexpected results with the claimed narrower range. For example, Applicant states that:

> In manufacturing a conventional PMR disk, to reduce a noise level of its PMR layer, the thickness of the PMR layer is determined to be a point at which the perpendicular coercivity *Hc* has a maximum value, thereby resulting in a minimal value of the noise level constant of proportionality α expressed as the formula (2). Pg. 7, ll. 19-22.

Applicant, then states that "a high-coercivity magnetic recording layer as thick as 50 nm or greater is not enough to reduce the noise level constant of proportionality, as shown in FIG. 5, for a pseudo double-layer PMR disk". Id. at 29-31. Applicant has discovered that:

> decreases in domain diameter are observed at a magnetic recording layer thickness smaller than the thickness at which the perpendicular coercivity *Hc* starts to decrease. Apparently, micro-domains can be formed at a reduced thickness of the magnetic recording layer. Also, the formation of micro-domains in the magnetic recording layer can induce a sharp reduction of the noise level constant of proportionality α, as shown in FIG. 5. Pg. 8, ll. 5-10.

In contrast, Suzuki is not concerned with the reduction of noise, but instead specifies a broad range of thickness of the recording layer 10 "from the viewpoint of recording and reproducing characteristics, and the thickness is not particularly specified". Col. 4, ll. 22-27 (emphasis added). Accordingly, Applicant asserts that Suzuki does not disclose the narrower claimed range with "sufficient specificity" to constitute an anticipation of the claims.

Based on the above, it cannot be said that that Suzuki describes the same structure, materials, or thickness described by Applicant as the Office asserts. Thus, the Office has not carried the burden of proof in showing inherency of the claimed feature of "the perpendicular magnetic recording layer having a thickness in the range where the ratio of perpendicular coercivity *Hc* to maximum perpendicular coercivity *Ho* decreases with reduced thickness of the perpendicular magnetic recording layer" in Suzuki. Accordingly, Applicant respectfully requests that the Examiner reconsider and withdraw the rejection of claim 1 based on Suzuki for at least this reason.

In addition to the absent feature identified above, Suzuki also fails to describe "an intermediate soft magnetic layer between the underlayer and the perpendicular magnetic recording layer for forming closed magnetic loops together with the p rpendicular magnetic recording layer", as required by claim 1. As discussed above, a closed magnetic loop includes an arrangement where the flux path external

to a permanent magnet is confined within high permeability materials that compose the magnetic circuit. Thus, claim 1 requires that the soft magnetic layer and the perpendicular recording layer form a closed loop without any intervening non-magnetic material.

In contrast, Suzuki's arrangements relied upon in the Action (e.g., FIGS. 1 and 2A) to support the rejection of the claims include a layer of non-magnetic material 20, 21 disposed between the soft magnetic layer 30, 31 and the information recording layer 10, 11. Accordingly, these arrangements cannot anticipate the claimed invention as the Office asserts.

Although Suzuki may describe double-layer arrangements that lack a non-magnetic material 20 (e.g. FIGS. 2B and 10B), the cited document does not describe, either explicitly or inherently, the layer made of soft magnetic material between the underlayer and the information recording layer forming closed magnetic loops together with the information recording layer.

The Office once again contends that this feature is "an unidentified property" that is inherent in the teachings of Suzuki. But as in the case of the thickness of the PMR layer discussed above, the Office fails to carry the burden of proof in showing that the claimed feature of "the soft magnetic layer between the underlayer and the perpendicular magnetic recording layer form closed magnetic loops together with the perpendicular magnetic recording layer" is an inherent property in any of Suzuki's arrangements.

For example, as discussed above, Suzuki's arrangements lack a same structure, material, and thickness as what is described and claimed in this application. In addition, nowhere does Suzuki describe an arrangement of the layer of soft magnetic material so as to form a closed magnetic loop together with the information recording layer. Moreover, Suzuki does not describe any magnetic circuit arrangement including the layer of soft magnetic material associated with the embodiments shown in FIGS. 2B and 10B, much less forming a closed magnetic circuit together with the information recording layer. Accordingly, Suzuki's arrangements cannot be said to anticipate the claimed invention. Thus, Applicant respectfully requests that the Examiner reconsider and withdraw the rejection of claim 1 based on Suzuki for at least this reason as well.

With respect to the obviousness rejection of claim 1 based on Suzuki, three criteria must be met to establish a *prima facie* case of obviousness. First, the cited documents must describe or suggest all of the claim features. Second, there must be some suggestion or motivation, either in the cited documents themselves or in the knowledge generally available to one of ordinary skill in the art, to have combined the teachings of the cited documents. Third, there must have been a reasonable expectation that the documents could have been successfully combined to yield the claimed invention.

The obviousness rejection cannot stand at least because Suzuki does not describe or suggest all of the claim features. For example, for the same reasons discussed above, Suzuki does not describe or suggest either "the perpendicular magnetic recording layer having a thickness in the range where the ratio of perpendicular coercivity *Hc* to maximum perpendicular coercivity *Ho* decreases with reduced thickness of the perpendicular magnetic recording layer", or " an intermediate soft magnetic layer between the underlayer and the perpendicular magnetic recording layer for forming closed magnetic loops together with the perpendicular magnetic recording layer".

In addition, motivations to modify the arrangements described in Suzuki to reach the claimed invention are lacking as well. For example, Suzuki discourages the use of arrangements that lack a non-magnetic layer, as evidenced by Suzuki use of such an arrangement, e.g., as depicted in FIG. 2C, as a comparative example for demonstrating the purported benefits of arrangements that include such non-magnetic layers. Accordingly, Applicant respectfully requests that the Examiner reconsider and withdraw the obviousness rejection of claim 1 over Suzuki as well.

Claims 1-15 also stand rejected for anticipation or obviousness over U.S. Patent No. 5,942,342 to Hikosaka et al. ("Hikosaka"). The Office asserts that Hikosaka discloses, In conjunction with the arrangement shown in FIG. 5, a perpendicular magnetic recording disk having an underlayer, an intermediate soft layer between the underlayer, and a perpendicular recording layer.

While Hikosaka may describe the claimed layers in conjunction with the arrangement shown in FIG. 5, the arrangement of FIG. 5 further includes a non-magnetic film 13 of Ti formed on the soft magnetic film 12, wherein the perpendicular magnetization film 1 of CoPtO formed on the nonmagnetic film 13. Col. 10, ll. 25-28.

Consequently, Hikosaka's arrangement shown in FIG. 5 must lack the claimed feature of "an intermediate soft magnetic layer between the underlayer and the perpendicular magnetic recording layer for forming closed magnetic loops together with the perpendicular magnetic recording layer", as the open-field arrangement includes a non-magnetic layer.

The remaining arrangements described throughout Hikosaka either include a non-magnetic layer 13 or lack an underlayer between a substrate and a perpendicular magnetic recording layer that is separate and apart from the soft magnetic layer, as is required by claim 1. For example, while Hikosaka does describe that "the soft magnetic film 12 and the antiferromagnetic film 14 constitute a underlayer", each of the described arrangements either lack this composite underlayer, lack a separate soft magnetic layer (e.g., layer 12) in addition to this composite layer, or include a non-magnetic layer 13 in the arrangement. Consequently, claim 1 does not read on any of Hikosaka's arrangements, and is considered allowable for at least this reason.

Hikosaka also fails to describe "the perpendicular magnetic recording layer having a thickness in the range where the ratio of perpendicular coercivity *Hc* to maximum perpendicular coercivity *Ho* decreases with reduced thickness of the perpendicular magnetic recording layer", as required by claim 1. The Office again acknowledges that Hikosaka does not expressly describe this feature, but asserts that the feature is inherent in Hikosaka's arrangements. To support this assertion, the Office again contends that the cited document discloses the same structure, materials, and thicknesses as applicant. Applicant respectfully disagrees.

Applicant's arguments against the Office's claim of inherency with respect to Suzuki apply, and are incorporated here by reference. Briefly, Hikosaka does not disclose the same structure as Applicant for the reasons stated immediately above. Namely, the arrangements described throughout Hikosaka either include a non-magnetic layer 13 or lack an underlayer between a substrate and a perpendicular magnetic recording layer that is separate and apart from the soft magnetic layer, as is required by claim 1.

Importantly, the thickness of Hikosaka's perpendicular magnetization film 1 is not the same as, or does not even overlap with, the thicknesses described in th examples provided in this application. For example, Hikosaka describes that "a 60-

nm thick perpendicular magnetization film 1 of CoPtO [is] formed on the nonmagnetic film 13". Col. 10, ll. 26-27. In contrast, all of the examples provided on pages 9 and 10 of this application describe a PMR layer having a thickness of 35 nm or less. Moreover, FIGS. 4 and 6 of this application show that for a PMR layer comprising CoCr, the ratio of perpendicular coercivity *Hc* to maximum perpendicular coercivity *Ho* decreases with reducing thicknesses of about 50nm and lower. Accordingly, claim 1 cannot be said to read on any of Hikosaka's arrangements for these reasons as well.

The subject matter defined by claim 1 is not obvious in view of Hikosaka either. First, as discussed above, Hikosaka lacks several features of the claimed invention, including: (1) "an intermediate soft magnetic layer between the underlayer and the perpendicular magnetic recording layer for forming closed magnetic loops together with the perpendicular magnetic recording layer", (2) an underlayer between a substrate and a perpendicular magnetic recording layer that is separate and apart from the soft magnetic layer, and (3) "the perpendicular magnetic recording layer having a thickness in the range where the ratio of perpendicular coercivity *Hc* to maximum perpendicular coercivity *Ho* decreases with reduced thickness of the perpendicular magnetic recording layer".

Moreover, a person skilled in the art would be motivated to modify the teachings of Hikosaka to reach the claimed invention for the following reasons. First, the myriad of exemplary arrangements provided by Hikosaka, all of which lack at least one layer of the claimed invention, appear to provide a "complete" solution to problems addressed in the document, and thus would not motivate one skilled in the art to remove or add layers to reach the claimed invention. Moreover, in the absence of any suggestion as to how or where to add or remove such layers, one would have faced a serious engineering problem that naturally would have had a low probability of success without substantial experimentation and effort.

Second, Hikosaka's statement that "the CoPt film can well function as a perpendicular magnetization film even if it is 100 nm or less thick", would discourage the formation of a PMR layer having a thickness in the range where the ratio of perpendicular coercivity *Hc* to maximum perpendicular coercivity *Ho* decreases with reduced thickness of the perpendicular magnetic recording layer, as required by claim 1. As discussed above, all of the examples provided on pages 9 and 10 of this

application describe a PMR layer having a thickness of 35 nm or less. Moreover, FIGS. 4 and 6 of this application show that for a PMR layer comprising CoCr, the ratio of perpendicular coercivity *Hc* to maximum perpendicular coercivity *Ho* decreases with reducing thicknesses of about 50nm and lower.

Notwithstanding the above, the subject matter defined by claims 3 and 4 are considered to be novel and inventive over the cited documents as well. For example, neither Suzuki nor Hikosaka describes or suggest the feature of the rate of variation of the ratio of perpendicular remanent magnetization of maximum perpendicular remanent magnetization in the range of thickness of the perpendicular magnetic recording layer is greater than of the ratio of perpendicular coercivity *Hc* to maximum perpendicular coercivity *Ho*.

Moreover, neither document describes that a noise level constant of proportionality α expressed as the following formula decreases with reduced thickness of the perpendicular magnetic recording layer:

$$\alpha = \frac{4\pi Mr}{Hc}$$

where *Mr* is the perpendicular remanent magnetization and *Hc* is the perpendicular coercivity.

Despite conventional beliefs that the noise in PMR disks can be reduced by increasing the thickness of the PMR layer, Applicant has discovered that decreases in domain diameter are observed at a magnetic recording layer thickness smaller than the thickness at which the perpendicular coercivity *Hc* starts to decrease, and that, apparently, micro-domains can be formed at a reduced thickness of the magnetic recording layer. Applicant has also discovered that the formation of micro-domains in the magnetic recording layer can induce a sharp reduction of the noise level constant of proportionality α, as shown in FIG. 5. See pg. 8, ll. 5-10.

For the foregoing reasons, Applicant believes entry of this Amendment would put the application in condition for allowance. Thus, it is respectfully requested that the Amendment be entered, and a Notice to this effect be provided. If any questions remain, the Examiner is invited to contact the undersigned at the below-listed telephone number.

Respectfully submitted,

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